



Staff Report

**USE INFORMATION AND AIR MONITORING
RECOMMENDATION FOR THE PESTICIDE ACTIVE
INGREDIENT ATRAZINE**

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USE INFORMATION AND AIR MONITORING RECOMMENDATION FOR THE PESTICIDE ACTIVE INGREDIENT ATRAZINE

A. BACKGROUND

This recommendation contains general information regarding the physical-chemical properties and the historical uses of the herbicide 6-chloro-*N*-ethyl-*N'*-(1-methylethyl)-1,3,5-triazine-2,4-diamine (atrazine). The Department of Pesticide Regulation (DPR) provides this information to assist the Air Resources Board (ARB) in their selection of appropriate locations for conducting pesticide air monitoring operations.

Atrazine (CAS: 1912-24-9) exists as a white crystalline solid or colorless powder. Atrazine has a molecular formula of $C_8H_{14}ClN_5$, and a molecular weight of 215.7 g/mole. Its solubility in water is 33 mg/L at 20°C. Alachlor is soluble in many organic solvents: methanol 15 g/L; ethyl acetate 24 g/L; acetone 31 g/L; dichloromethane 28 g/L; toluene 6.0 g/L; *n*-hexane 0.11 g/L; *n*-octanol 8.7 g/L (all at 25°C). It has a Henry's Constant of 1.97×10^{-9} atm·m³/mol at 22 °C, and a vapor pressure of 2.34×10^{-7} at 22°C. Atrazine is relatively stable in neutral, weakly acidic and weakly alkaline solution. In the presence of strong acids and alkalis, and at 70°C in neutral media, atrazine rapidly hydrolyses to the hydroxy derivative (Kollman and Segawa, 1995; Tomlin, 1994).

Soil-applied atrazine is a widely-used selective herbicide for control of broadleaf and grassy weeds in corn, sorghum, rangeland and turf grass sod. In soil, atrazine undergoes hydrolysis

Alachlor's acute oral LD₅₀ varies depending on formulation. In rats, technical alachlor's acute oral LD₅₀ was 930 mg/kg. The acute oral LD₅₀ (rat) for the formulations Lasso® (emulsifiable concentrate), Lasso EC® (emulsifiable concentrate), Lasso II® (granular/flake), and Bronco® (liquid)[†] were 2,416 mg/kg, 1,000 mg/kg, >5,010 mg/kg, and 3,152 mg/kg, respectively. The LC₅₀ (96 hour) is 1.8 mg/L for rainbow trout, and 2.8 mg/L for bluegill sunfish for technical-grade alachlor. However, for Lasso EC formulation, the LC₅₀ (96 hour) increased to 4.2 mg/L and 6.4 mg/L for rainbow trout and bluegill sunfish, respectively. Alachlor entered the risk assessment process at DPR under SB 950 (Birth Defect Prevention Act of 1984) based on oncogenic and chronic effects plus a low No-Observed-Effect level (NOEL).

B. USE OF ALACHLOR

As of July 24, 1997, three alachlor-containing products were registered for use in California. Alachlor is a selective herbicide for pre- and postemergence weed control registered for use on corn, beans, and woody ornamentals. DPR regulates alachlor as a restricted use pesticide when it is used for the production of agricultural plant commodities. Restricted use

[†] Lasso, Lasso EC, Lasso II, and Bronco are registered trademarks of the Monsanto Company, St. Louis, Missouri.

pesticides may be possessed and used only by certified applicators who have obtained a special permit from their county agricultural commissioner.

With DPR's implementation of full pesticide use reporting in 1990, all users must report the agricultural use of any pesticide to their county agricultural commissioners, who subsequently forward this information to DPR. DPR compiles and publishes the use information in the annual Pesticide Use Report (PUR). Because of California's broad definition for agricultural use, DPR includes data from pesticide applications to parks, golf courses, cemeteries, rangeland, pastures, and rights-of-way, postharvest applications of pesticides to agricultural commodities, and all pesticides used in poultry and fish production, and some livestock applications in the PUR. DPR does not collect use information for home and garden use, or for most industrial and institutional uses. The information included in this monitoring recommendation reflects cropland applications of alachlor. Use rates were calculated by dividing the total pounds of alachlor reported used (where alachlor was applied to acreage) by the total number of acres reported treated.

According to the 1995 PUR, over 90 percent of California's total alachlor use occurs in eleven counties (Table 1). Historically, cropland applications account for over 99 percent of the total amount of alachlor reported used each year. Non-cropland applications—rights-of-way—account for less than one percent of the total amount of alachlor reported used each year.

In California, growers use alachlor to selectively control yellow nutsedge and a variety of annual grasses and broadleaf weeds in corn and dry beans, and to a lesser extent, in sorghum. Labeled use rates for alachlor range from 2.5 to 4.0 pounds active ingredient (AI) per acre. The highest rates are associated with heavy infestations of yellow nutsedge. Alachlor is available as an emulsifiable concentrate, a granular/flake, and in a microencapsulated formulation. Alachlor-containing products include the Signal Words "Warning," "Caution," or "Danger" on their labels, depending on the product formulation or the percent AI in the product.

Table 1. Annual Agricultural Use of Alachlor (Pounds of Active Ingredient)

COUNTY	1995	1994	1993	1992
Solano	10,166	7,374	5,793	13,676
Ventura	6,163	4,380	2,758	5,067
Fresno	4,494	4,440	5,312	10,207
Santa Barbara	4,148	5,268	8,970	6,554
Glenn	3,154	2,489	2,312	4,449
Sacramento	3,106	1,730	2,481	5,076
Yolo	2,393	1,600	2,436	12,103
Colusa	1,603	1,166	814	64
San Joaquin	1,476	1,695	4,348	6,346
Butte	888	2,718	2,136	2,883
Monterey	870	1,726	927	1,960
County Totals	38,461	34,586	38,287	68,385
<i>Percent of Total</i>	94	81	85	83
CALIFORNIA TOTAL	41,118	42,854	44,957	82,046

According to the PUR, the total annual amounts of alachlor used in 1993-1995 were approximately half of the annual totals used in earlier years. Solano County routinely receives the greatest applications of alachlor; where growers apply nearly 25 percent of all the alachlor used in 1995. Table 2 summarizes the total amounts and average daily rates of alachlor reported applied in Solano County during the months of greatest use. In 1994 and 1995, the highest use occurred in late-May through June. In earlier years, the highest use began earlier in May, and applications were largely complete by mid-June. Preliminary 1996 use data follows patterns similar to those of 1994 and 1995. For all years, the highest use was associated with applications to corn and bean crops.

The maximum label rate is 4.0 lbs AI per acre for the control of severe infestations of yellow nutsedge. In practice, however, the maximum rate is seldom used; however, when the highest rate is used, it is associated with May-June applications to corn. While applications to corn occasionally occur at 4.0 lbs per acre, they generally occur at much lower rates of use. According to the PUR, the second highest rate of use is 3.0 lbs AI per acre in bean crops, and occurs consistently from late May through July, in several counties throughout the State, including Solano County.

Table 2. Alachlor Applications in Solano County

MONTH	<u>1995</u>		<u>1994</u>		<u>1993</u>		<u>1992</u>	
	<i>Lbs Used¹</i>	<i>Rate²</i>	<i>Lbs Used¹</i>	<i>Rate²</i>	<i>Lbs Used¹</i>	<i>Rate²</i>	<i>Lbs Used¹</i>	<i>Rate²</i>
May	1,702	3.2	1,734	3.9	3,347	2.5	7,770	3.1
June	5,432	3.2	2,335	3.2	707	3.3	3,167	3.2
July	1,677	2.4	1,539	2.5	767	3.0	118	3.2

¹ In pounds of active ingredient.² Average rate (in pounds of active ingredient per acre).

C. RECOMMENDATIONS

1. Ambient Air Monitoring

The historical trends in alachlor use suggest that monitoring should occur over a 30- to 45-day sampling period in the corn and bean growing regions in northern Solano County from mid-May through early July. Figure 1 shows applications routinely begin in early May, reach a peak during June, then tail off throughout July. Figure 2 displays the areas of alachlor use by section in Solano County for 1994-1995. Because alachlor is a restricted material, the county agricultural commissioner must issue a permit to each user before it is applied. These permits include information such as application site locations. For these reasons, DPR strongly recommends close coordination with the county agricultural commissioner to select the best sampling sites and periods.

Three to five sampling sites should be selected in relatively high-population areas or in areas frequented by people. Sampling sites should be located near corn and bean growing areas. Ambient samples should not be collected from samplers immediately adjacent to fields or orchards where alachlor is being applied. At each site, twenty to thirty discrete 24-hour samples should be taken during the sampling period. Background samples should be collected in an area distant to alachlor applications.

Replicate (collocated) samples are needed for five dates at each sampling location. Two collocated samplers (in addition to the primary sampler) should be run on those days. The dates chosen for replicate samples should be distributed over the entire sampling period. They may, but need not be, the same dates at every site. Trip blank and field spike samples should be collected at the same environmental conditions (e.g., temperature, humidity, exposure to sunlight) and experimental conditions (e.g., air flow rates) as those occurring at the time of ambient sampling.

2. *Application-Site Air Monitoring*

The historical trends in alachlor use suggest that application-site air monitoring should be conducted from late-May through the first week in July in Solano County. Ideally, monitoring should be conducted in association with an application of alachlor at the highest label rate (i.e., a pre-plant application to corn at 4.0 lbs per acre). Applications to corn occur in the area identified in Figure 2. However, 4.0 lbs per acre applications to corn are not widespread, and occur sporadically. Consequently, as an alternative, monitoring may be conducted in association with application to beans (Figure 3), provided a 4.0 lbs per acre application to corn cannot be readily located in the County. Figure 4 displays the sections in northern Solano County where alachlor was applied to bean crops in 1994 and 1995. Preliminary 1996 PUR data agrees with 1994-95 PUR data. For an application to beans, monitoring should occur at a site of the highest rate of use in this crop—3.0 pounds AI per acre. Because alachlor is a restricted material, the county agricultural commissioner must issue a permit to each user before it is applied. These permits include information such as application site locations. Again, a successful monitoring study depends upon close coordination with the county agricultural commissioner to select the best sampling sites and dates. Alachlor may be intensively applied in nearby fields during this period so care should be taken to prevent nearby applications from contaminating collected samples.

A three day monitoring period should be established with sampling times as follows: application + 1 hour, followed by one 2-hour sample, one 4-hour sample, two 8-hour samples and two 24-hour samples. A minimum of four samplers should be positioned, one on each side of the field. A fifth sampler should be collocated at one position. Since alachlor is extensively used in the area, background samples should collect enough volume (either 12 hours at 15 liters/min, or a shorter period with a higher volume pump) to permit a reasonable minimum detection level. Ideally, samplers should be placed a minimum of 20 meters from the field. Trip blank and field spike samples should be collected at the same environmental conditions (temperature humidity, exposure to sunlight) and experimental conditions (similar air flow rates) as those occurring at the time of sampling.

Additionally, we request that you provide in the monitoring report: 1) an accurate record of the positions of the monitoring equipment with respect to the field, including the exact distance that the sampler is positioned from the field; 2) an accurate drawing of the monitoring site showing the precise location of the meteorological equipment, trees, buildings, and other obstacles; 3) meteorological data collected at a minimum of 15-minute intervals including wind speed and direction, humidity, and air temperature, and comments regarding degree of cloud cover; and 4) the elevation of each sampling station with respect to the field, and the orientation of the field with respect to North (identified as either true or magnetic North).

D. SAFETY RECOMMENDATIONS

According to the product labels, alachlor is a restricted use pesticide because of its oncogenicity. Alachlor has been determined to cause tumors in laboratory animals. Additionally, alachlor is an eye irritant and respiratory tract irritant. Repeated skin contact may cause an allergic reaction. The labels specify a post-application reentry interval of 12 hours. If the pesticide was soil applied or soil injected, the label allows workers to reenter the treated area earlier than 12 hours post-application, provided there will be no contact with anything that has been treated.

Monitoring personnel should use proper protective equipment to prevent exposure to the vapors or spray mist. According to the product labels, proper protective equipment for applicators includes Tyvek[®] coveralls over long-sleeved shirt and long pants, water-resistant gloves, chemical resistant footwear plus socks, and protective eyewear. Monitoring personnel should refer to the label of the actual product used for further precautions.

E. REFERENCES

- Kelley, K. and N.R. Reed. 1996. Pesticides for evaluation as candidate toxic air contaminants. Department of Pesticides Regulation. Sacramento, California. Report No. EH 96-01.
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- Royal Society. 1993. Alachlor. Agrochemicals Handbook, 3rd edition, Royal Society of Chemistry, London.